Aura Validation Working Group Report

(Lucien Froidevaux)

AGENDA: Aura Validation Working Group Meeting

(L. Froidevaux, A. Douglass)

MONDAY, OCTOBER 1, 2007, 1:30 – 5:30 p.m.

● **Validation Status, Issues, Plans**		**100 mins.**
- HIRDLS	J. Gille/B. Nardi	[25 mins.]
- MLS	L. Froidevaux	[25 mins.]
- OMI	M. Kroon	[25 mins.]
- TES	G. Osterman	[25 mins.]
● **Recent/New campaigns**		**90 mins.**
- Large Balloons: Kiruna, Ft. Sumner 2007 and Table Mountain NO2 Intercomparison	J. Margitan	[10 mins.]
- WAVES	D. Whiteman	[10 mins.]
- MOHAVE	T. Leblanc	[10 mins.]
- UT/LS H2O validation issues	K. Rosenlof / D. Fahey	[10 mins.]
- TC4	M. Schoeberl	[10 mins.]
- SAUNA	R. McPeters	[10 mins.]
- CESAR	P. Levelt	[10 mins.]
- ARCTAS	D. Jacob	[15 mins.]
● **AVDC Status**	C. Retscher / B. Bojkov	**10 mins.**
Discussion (data access, longer-term plans,…)		**5 mins.**
● **Future goals / suggestions for the working group**	Discussion	**10 mins.**

HIRDLS: Summary of quality of validation products

Temperature:

P-Range: 1-300 hPa
Precision: 0.5K at 10-100 hPa; 1K @ 1 hPa (v2.02.07)
Accuracy: ±2K at 1-100 hPa

Ozone:

Range: 1-100+ hPa (mid-high Lat), 1-50 hPa (tropics)
Precision: 5-10%
Accuracy: 2-10% at 1-10 hPa; biased generally low
5% high bias ~10-30 hPa
0-20% low bias, ~30-100+ hPa (mid & high latitudes)

Nitric Acid:

Range: 10-100 hPa, 10-50 hPa (tropics)
Precision: 10-35% at 100-10hPa
Accuracy: ~10% (at 10hPa) to 30% (at 100hPa); biased low [ACE-FTS]

Clouds/Aerosol:

Range: 400 hPa- 10 hPa
Correlation with other instruments:
SAGE & HALOE (cloud-top pressure): 0.85 - .93
CALIPSO horizontal cloud scale: 0.99
Extinction retrieval successful at rate 70%: needs improvement

Vertical Resolution: 1-2 km

Status of HIRDLS data products

1. Temperature, Ozone, HNO_3, clouds – Released [v2.04.09]

2. H_2O, CFC-11, CFC-12 – Not ready to release;
   now most promising for future releases

3. CH_4, NO_2, N_2O, $ClONO_2$, N_2O_5 – Not ready to release.

Current MLS Validation Issues / Needs

Product	Validation Issue / Investigation	Data Source Needs / Reason
Temperature and GPH	Some retrieval biases, 2-3K vertical structure issue.	
H_2O (and relative humidity)	"Kink" in MLS profiles near 30 hPa. Low bias near 200 hPa vs CFH and Vaisala; high bias for VMR > 500 ppmv.	Resolve aircraft in situ vs CFH profile diffs. → improve validation robustness.
N_2O	Possibly extension of vertical range (to 150 hPa).	
O_3	Extension of vertical range (UT); more MOZAIC and UT studies.	More sonde matches under enhanced O_3 conditions in UT, for better statistics.
CO	Resolve UT biases ($P \geq 215$ hPa); extend data to higher P.	More UT CO data; mainly via MOZAIC (+ sat cross-val.) + ARCTAS?
HCl	Better understand diffs. in 2007 Kiruna campaign; also, some small notches in MLS profiles.	Depends on Kiruna data investigation (Kiruna 2?).

Current MLS Validation Issues / Needs

Product	Validation Issue / Investigation	Data Source Needs / Reason
HNO_3	MLS low bias (~1 ppbv or 10 – 30%)	
ClO	Improve retrievals for negative biases at P > ~ 30 hPa.	Possibly more validation in polar vortex
BrO	Extend vertical range; reduce biases and latitudinal oscillations	
OH, HO_2	Better understand residual diffs. in comparisons	Balloon flight in Ft. Sumner, Fall 2008 (for reason at left)
HOCl	Continuing validation; extension of vertical range (into LS)	More balloon flight data to resolve differences between model & data (balloon, MLS)
Cloud ice	Broader multi-sensor comparisons (IWC, IWP, cloud fraction) + enhanced MLS retrievals	Improved "climatology" of cloud particle characteristics

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Current OMI Retrieval / Validation Needs

Product	Retrieval Needs	Validation Needs
Nitrogen dioxide (total and trop. NO2 column)	Surface in-situ and Vertical Profiles in polluted regions Effective Cloud Fraction and Effective Cloud Height Surface Albedo data at OMI spatial resolution	Ground Truth Standard in-situ detection networks Total NO2 column network of remote sensing standard (e.g. direct sun) Tropospheric Columns in polluted regions
Ozone (total and trop. O3 column, O3 profiles)	Total O3 columns and profiles at high SZA (SAUNA-III) Surface Albedo data at OMI spatial resolution	Continuation Brewer network More Double Brewers at high lat. and in SH SHADOZ balloons, trop. ozone lidar, MaxDOAS
Aerosols (AOD and SSA)	Microphysics (type, size, chem, phys, distributions) Aerosols type statistics Surface Albedo data at OMI spatial resolution	Continuation Aeronet network Airborne campaigns gathering aerosol microphysics statistics (in particular, polluted regions)

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Current OMI Retrieval / Validation Needs

Product	Retrieval Needs	Validation Needs
Sulphur Dioxide (total SO2 column [PBL, 5 km, 15 km])	Profiles in polluted regions and regions of outflow Emphasis on PBL Volcanic plume tomography Simultaneous observation of aerosols and SO2 profiles Surface Albedo data at OMI spatial resolution	Double Brewer instrum. Advanced Double Brewer SO2 algorithm MaxDOAS instruments for total column and profiling Aircraft observations of plumes (volcanic and industrial)
Clouds (effective fraction and height)	Cloud model (LER, MLER, plane parallel) Surface Albedo data at OMI spatial resolution	More comparisons of cloud fraction by sat-sat comparisons Effective Cloud Height by ground radar / lidar
Minor trace gases (total BrO, HCHO, CHO-CHO columns) (slant OClO column)	Surface Albedo data at OMI spatial resolution	MaxDOAS instruments Satellite data

Current TES Validation Issues / Needs

Product	Validation Issue	Data Source
L1B Radiances	Radiometric stability, Emissivity issues over cold surfaces	Future Scanning-HIS flights (ARCTAS?)
Temperature, Water Vapor	Improving nadir retrievals	More CFH sondes, particularly in clear-sky ocean conditions timed with Aura overpass (Closure experiments)
Nadir Ozone	High bias in troposphere	More high latitude sondes (ARCTAS?)
HDO	Lack of validation data	Unknown
Methane	High bias	Profile Information (150 to 500 hPa) DACOM (ARCTAS)

TES Future Validation Analyses

- High bias in nadir ozone, improvement in nadir temperature profiles
  - Use current set of sonde measurements
  - TES V004 data → 2008
- Continued validation of limb products
- HDO, Methane
- Nadir ozone in the stratosphere, limb ozone using MLS, HIRDLS

Recent/New campaigns (Overviews)

- **Large Balloons: Kiruna, Ft. Sumner 2007 and Table Mountain NO_2 Intercomparison** **J. Margitan**

  > Kiruna, Sweden balloon campaign

  2007 Jan 24: FIRS2/SLS/Ozone

  2007 Feb. 22: MkIV (ascent data only – balloon burst at float)

  Flights deep in very cold, perturbed vortex

  Some recent comparisons have been produced [also, *Stachnik et al.* presentation]

  > 2007 Sep. 22 Ft. Sumner, NM balloon campaign

  MkIV/SLS/FIRS2/BOH/Ozone

  31 hour flight (but no FIRS2 data due to malfunction)

- **WAVES** **D. Whiteman**

  Many coordinated measurements from Beltsville area; clean and polluted conditions

  WAVES 2006 (June 27 – August 12, 2006)

  WAVES 2007 (July 14 – August 8, 2007)

  Sondes (includes PTU, ozonesondes, CFH); Microwave Radiometer, 7 lidar systems

  O_3, H_2O, aerosols, Temperature data; coordinated with A-train overpasses.

  - Some Vaisala sonde calibration issues vs CFH
  - Precipitable water: AIRS and TES biased high vs MWR (and GPS)
  - Some airborne lidar data also mentioned for TES/CALIPSO validation (H_2O, aerosol variability)

  Some Aura results included as part of several validation papers (JGR special issue)

Recent/New campaigns (Overviews)

- MOHAVE **T. Leblanc**

MOHAVE-1 campaign (October 2006)

> to assess the measuring capabilities of Water Vapor Raman lidars (part of NDACC)
5 lidars, 50+ PTU sondes, 10 CFH sondes, 2 GPS, 1 microwave,…
→ wet bias of Raman lidars versus CFH above ~12 km
Major Finding: Fluorescence in lidar receiver optic fiber, can be removed by blocking. Also, Miloshevic's empirical correction to Vaisala RS92 seems to work well.

MOHAVE-2 campaign (October 2007) planned to now refine comparisons, check sensitivity limits (lidars probably need more power, etc… to measure higher up)

Note: Short-term variability in H2O observed by lidars
→ complicates Aura validation (some good results anyway, on-going)

-**UT/LS H2O validation issues** **K. Rosenlof / D. Fahey**

2 main topics of current interest

> Establishing the frequency and temperature dependence of supersaturation.
Various datasets indicate persistent S > 1.2 inside and S > 1.6 outside clouds
Causes under investigation…

> Establishing instrumental accuracy at low water vapor values and low temperatures
Intercomparison campaign of water vapour measurement techniques to be held in the AIDA Chamber in Karlsuhe, Germany October 8th - November 2nd, 2007; for wide range of T, P, H_2O will be tested (with/without aerosols, ice particles).

Recent/New campaigns (Overviews)

-**TC4 (Costa Rica; mid-July to early August 2007)** **M. Schoeberl**

3 aircraft + sondes

> ER2 - mostly full participation - but landed before Aura overpass

> DC8 - mostly full participation - bulk of Aura validation

> WB57 - Only 3 CR flights near the end of the mission - landed before overpass.

Good validation data despite mission problems - SO_2, NO_2, Ozone

Not as much TTL data as we would have liked

Workshop early next year

- SAUNA **R. McPeters**

For total column O_3, satellite measurements agree within 2-3% globally

Differences at low sun, high column amounts, high reflectivities, etc.

Need to verify the accuracy of GB measurements for satellite validation purposes

SAUNA: March-April 2006 ; *SAUNA 2: February-April 2007*

Combined network instruments: Dobsons, Brewers, DOAS, sondes and LIDAR

> Conclude that data from double Brewers should be used for Aura O3 val at high SZA

> The state of the network calibration (Brewer and Dobson) is uncertain

> With improved GB calibration, differences between OMI and GB most probably due to ozone X-sections uncertainties; high spectral resolution X-sections required which can be used by both satellites and ground-based instruments

- **CESAR** **P. Levelt**

  > NO_2 and O_3 campaign in May 2008, Cabauw, The Netherlands (along with the EUCAARI IOP campaign – clouds and aerosols)

  > Also intend to play a part in the AMFIC project (SO2 and NO2 in China) with the Mini-MAX DOAS

  Continuous measurements at De Bilt (KNMI) and / or Cabauw of NO2 and O3

  If you wish to get involved, please contact Pieternel

- **ARCTAS** **D. Jacob**

  Planning two 3-week deployments:

  April 2008 (Fairbanks/Thule), July 2008 (Edmonton)

  Three NASA aircraft: DC-8 (in situ chemistry and aerosols), P-3B (radiation and in situ aerosols), B-200 (aerosol remote sensing & CALIPSO validation)

  Science Theme 1: Transport of mid-latitudes pollution to the Arctic

  Science Theme 2: Boreal forest fires

  Science Theme 3: Aerosol radiative forcing

DC-8: in situ chemistry and aerosols

Likely Payload: O3, H2O, CO, CO2, CH4, NOx and HOx chemistry, BrO, mercury, NMVOCs, halocarbons, SO2. HCN/CH3CN, actinic fluxes, aerosol composition/concentrations/properties, remote ozone and aerosol

For relevant (high lat. April / July) Aura Validation needs/wishes, please contact Daniel with requests

[see also Aura needs lists above (some still to come)]

- **AVDC Status** **C. Retscher / B. Bojkov**
  - > ***Support continuing (Aura teams like this!...)***
  - > HDF5 read/write in final testing for correlative data
    - > Focus shifting to long-term validation
      - Collect and update ground datasets
      - Data completeness
      - Continue ESA/NDACC efforts
      - Share datasets and coordinate submissions
      - Proactive on AVDC side but need support from cal/val and instrument teams

- **Please provide inputs to AVWG chairs + Aura instr. val. reps. on future campaign wishes/needs, and AVWG activities & structure in the future**